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Fast Track Randomized Controlled Trial to Prevent Externalizing Psychiatric Disorders:

Findings From Grades 3 to 9

CONDUCT PROBLEMS PREVENTION RESEARCH GROUP
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Abstract

Objective—This study tests the efficacy of the Fast Track Program in preventing antisocial behavior and psychiatric disorders among groups varying in initial risk.

Method—Schools within four sites (Durham, NC; Nashville, TN; Seattle, WA; and rural central Pennsylvania) were selected as high-risk institutions based on neighborhood crime and poverty levels. After screening 9,594 kindergarteners in these schools, 891 highest risk and moderate-risk children (69% male and 51% African American) were randomly assigned by matched sets of schools to intervention or control conditions. The 10-year intervention (begun in 1991 with three yearly cohorts) included parent behavior-management training, child social-cognitive skills training, reading tutoring, home visiting, mentoring, and a universal classroom curriculum. Outcomes included criterion counts and psychiatric diagnoses after grades 3, 6, and 9 for conduct disorder, oppositional defiant disorder, attention-deficit/hyperactivity disorder, any externalizing disorder, and self-reported antisocial behavior. Grade 9 outcomes were assessed between 2000 and 2003, depending upon cohort.

Results—Significant interaction effects between intervention and initial risk level were found at each age but most strongly after grade 9. Assignment to intervention had a significant positive effect in lowering criterion count scores and diagnoses for conduct disorder, attention-deficit/hyperactivity

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Inhalant Abuse Janet F. Williams, MD Michael Storck, MD, and the Committee on Substance Abuse and Committee on Native American Child Health

Inhalant abuse is the intentional inhalation of a volatile substance for the purpose of achieving an altered mental state. As an important, yet-underrecognized form of substance abuse, inhalant abuse crosses all, demographic, ethnic, and socioeconomic boundaries, causing significant morbidity and mortality in school-aged and older children. This clinical report reviews key aspects of inhalant abuse, emphasizes the need for greater awareness, and offers advice regarding the pediatrician’s role in the prevention and management of this substance abuse problem. **Peddiatrics** 2007;119:1009-1017.

disorder, and any extemalizing disorder, and lowering antisocial behavior scores, but only among those at highest risk initially.

Conclusions—Prevention of serious antisocial behavior can be efficacious across sex, ethnicity, and urban/rural residence, but screening is essential.

Keywords

prevention; aggression; conduct disorder; randomized trial

According to the recent National Institutes of Health State-of-the-Science Panel Report on the Prevention of Violence (National Institutes of Health, 2004), no early intervention program has prevented the long-term diagnosis of conduct disorder. One explanation involves the large number of factors that contribute to antisocial behavior, factors that may become chronic and intractable by adolescence. The early-starter model (Moffitt, 1993; Patterson et al., 1992) posits two groups of antisocial youth. The first group has been labeled “adolescence-limited”; their early behavior problems are only moderately problematic and occur only during adolescence. In contrast, an “early-starter” group initiates antisocial behavior in early childhood, and this behavior persists across the lifespan. Because they can be identified by age 5, the early-starter group is a prime target for long-term prevention (Lochman et al., 1995). These children are the focus of this report.

The prevention of serious violence among the early-starter group has been guided by the propositions that their behavior depends on socialization by parents, peers, and school institutions during middle childhood (Coie, 2004) and that only sustained intervention with multiple agents of socialization can interrupt the trajectory toward chronic violence. Longitudinal studies (Laird et al., 2003; Patterson et al., 2000) indicate that inconsistent, coercive parenting in elementary school and poor monitoring and supervision in middle school exacerbate early conduct problems. Intervention to improve parenting across these developmental periods may prevent antisocial behavior. The model also proposes that successful peer relationships, especially in social acceptance during elementary school and avoidance of deviant peer associations during middle school, can prevent escalation of antisocial behavior (Dishion, 2006; Dodge et al., 2003; Patterson et al., 1992) as can the enhancement of social-cognitive and academic skills (Dodge and Pettit, 2003). Previous interventions in single domains have yielded short-term success, but those effects have diminished across time (Coie, 2004; Johnson, 2005). The failure of these programs over the long term may reflect both the lack of comprehensiveness of past interventions and the insufficient duration of intervention.

The Fast Track study (Conduct Problems Prevention Research Group, 1992) is a randomized clinical trial premised on the hypothesis that serious behavior problems among those at highest risk can be prevented by comprehensive and long-term intervention providing age-relevant skills training, peer relationships, and parenting practices. Services target the three crucial elements of the developmental model: child social-cognitive and cognitive skills, peer relationships, and parenting. The intent-to-treat research design contrasted the multicomponent intervention with a treatment-as-usual control group. Previous articles have reported proximal success of the intervention in improving social-cognitive and cognitive skills, peer relationships, parenting skills, and classroom disruptive behavior during elementary school (e.g., Conduct Problems Prevention Research Group, 1999a, 2002a, 2004). No report has yet examined serious antisocial behavior or psychiatric diagnoses.

One controversy is whether preventive interventions are equally efficacious with youth at various levels of initial risk for antisocial outcomes (Dodge and Sherrill, in press). The present study was planned with enough participants who varied in initial risk levels to test whether

intervention would be equally efficacious across levels. The recent discovery of an interaction between genetic predispositions and socialization effects in predicting conduct disorder (Caspi et al., 2002) suggests that life experiences, whether naturally occurring or through systematic intervention, may most strongly influence children who are at highest dispositional risk. Likewise, the nurse-practitioner home-visiting program has proven successful in preventing antisocial behavior at age 15, but only among families at the highest end of initial risk (Olds et al., 1998). Thus, we examined both main effects and the hypothesis that the Fast Track intervention would interact with risk level and would be more effective with highest risk children than moderate-risk children. Risk level was initially conceptualized and tested as a continuous variable, but discrete risk-level groups were also formed for descriptive purposes. Finally, psychiatric interviews were completed after grades 3, 6, and 9 so that intervention efficacy could be tested across time.

METHOD

Participants

Local public elementary schools within the four sites (Durham, NC; Nashville, TN; Seattle, WA; and rural central Pennsylvania) were selected as high risk based on neighborhood crime and poverty. Within each site, schools were divided into multiple paired sets matched for demographics (size, percentage free or reduced lunch, ethnic composition), and one of each pair was randomly assigned to intervention and control conditions. Although there were substantial differences across sites in the degree of risk shown by their respective schools, there was considerable risk in the typical study school. The overall percentage of children receiving free or reduced lunch was 55% (ranging from 39% in rural Pennsylvania to 80% in Durham). The mean percentage of ethnic minority children (primarily African American) attending the schools was 49% (ranging from 1% in rural Pennsylvania to 90% in Durham). A series of ANOVAS indicated no significant differences between intervention and control schools on the percentage of children who received free and reduced lunch, percentage of ethnic minority children, or academic achievement scores. In addition, there were no intervention versus control differences on baseline behavior problems as assessed by the Teacher Observation of Child Adjustment-Revised (TOCA-R) Authority Acceptance score (Conduct Problems Prevention Research Group, 1999b)

Figure 1 is a flowchart of study participation. Using a multiplegating screening procedure that combined teacher and parent ratings of disruptive behavior (Lochman et al., 1995), all 9,594 kindergarteners across three cohorts (1991-1993) in 54 schools were screened initially for classroom conduct problems by teachers, using the TOCA-R Authority Acceptance score (Werthamer-Larsson et al., 1991). Children scoring in the top 40% within cohort and site were then solicited for the next stage of screening for home behavior problems by the parents, using items from the Child Behavior Checklist (Achenbach, 1991a) and similar scales (Lochman et al., 1995), and 91% agreed to participate at this stage (n = 3,274). The teacher and parent screening scores were then standardized and combined into a sum score, based on screening a representative sample of approximately 100 children within each site (which also served as a normative comparison) and then summed to yield a total severity-of-risk screen score. Children were selected for inclusion in the study based on this screen score, moving from the highest score downward until desired sample sizes were reached within sites, cohorts, and conditions. Deviations were made when a child failed to matriculate in the first grade at a core school (n = 59) or refused to participate (n = 75), or to accommodate a rule that no child would be the only girl in an intervention group. A total of 95% of the selected sample scored in the top 20% on both the parent and teacher screening measures. The outcome was that 891 children. (n = 445 for intervention and n = 446 for control) participated. Note that these levels of problems are defined relative to other children in these high-risk schools. On the kindergarten Teacher's

Report Form of the Child Behavior Checklist (Achenbach, 1991b), the nationally normed (mean 50, SD 10) average Externalizing *T* score (available for 88% of the high-risk sample) was 66.4, and 76% of these children scored in the clinical range (*T* scores of ≥60).

The mean age of participants was 6.5 years (SD 0.48) at the time of identification. Across all of the sites, the sample was ethnically heterogeneous (51% African American, 47% European American, and 2% of other ethnicity [e.g., Pacific Islander, Hispanic]) and sex mixed (69% boys). The sample was skewed toward socioeconomic disadvantage: 58% were from single-parent families, 29% of parents were high school dropouts, and 35% of the families were in the lowest socioeconomic class as scored by Hollingshead (1975).

In addition to the high-risk sample, a stratified normative sample of 387 children was identified to represent the population-normative range of risk scores and was followed over time. These children were not a part of the major analyses but are included here so that outcomes for the intervention group may be contrasted with those of the normative samle to determine whether they reached normative rates.

Written consent from parents and oral assent from children were obtained. Parents were paid for completing interviews, and intervention-group parents were paid for group attendance. All of the procedures were approved by the institutional review boards of the participating universities.

To improve the precision of the estimates of intervention effects, guard against any departures from randomization, and protect against differential attrition, 20 variables were measured before the initiation of intervention and were included as covariates in outcome analyses. These variables measured children's baseline behavior problems, family demographics and social ecology, children's cognitive and social skills; and parenting. Previous analyses confirm no statistical difference between the intervention and control samples for preintervention scores (Conduct Problems Prevention Research Group, 2002a). Table 1 reports data on intervention and control groups for the 20 baseline covariates. Three variables showed significant differences at the $p < .05$ level, which is a slightly but not significantly greater number of differences than would be expected by chance. Additional tests compared intervention and control groups within subgroups at highest and moderate risk and did not yield strong evidence of systematic bias. We included these baseline characteristics in our analysis models to avoid potential bias due to observed imbalances as well as to improve precision. Further information on each of the baseline covariate measures can be obtained from the corresponding author.

Attrition averaged 20%/year: 18% of intervention children and 23% of control children did not participate in the follow-up interview before grade 10 ($\chi^2_1 = 3.28$, $p < .07$). *t*-Tests indicated that youths who remained in the study and youths who did not differed on only 2 of 20 baseline variables (retained youths had higher scores than attrited youths for baseline emotion recognition accuracy and WISC IQ). Further tests indicated that attrition did not lead to differences between intervention and control groups (only 1 of 20 tests was significant).

Intervention Procedures

Great effort was expended to offer a coherent array of services across 10 years to each family in the intervention condition. During the elementary school phase of the intervention (grades 1-5), all of the families were offered parent training with home visiting, academic tutoring, and social skills training, Parent and child group interventions were conducted during a 2-hour "enrichment program." During the first 60 to 90 minutes of this enrichment program, high-risk target children met in groups of 5 or 6 in "friendship groups" led by educational coordinators (Bierman et al., 1996), while parents met in a group led by family coordinators to discuss parenting strategies that would support child school adjustment and improve child behavior

(McMahon et al., 1996). In the following 30 minutes, parent-child pairs participated in positive cooperative activities and practiced positive parenting skills with staff support, called Parent-Child Sharing Time. In first grade paraprofessional tutors also provided 30 minutes of reading tutoring during the enrichment program. In addition, the tutors provided two more reading tutoring sessions each week, along with a weekly peer-pairing session to improve friendships with classmates, to all intervention children in grade 1.

Group meetings were held weekly during grade 1 for 22 sessions, biweekly during grade 2 for 14 sessions, and monthly during grades 3 to 6 for 9 sessions each year. In addition, individual support was provided through home visiting (Dodge, 1993) to help parents generalize the skills presented in the group setting and to address individual needs.

Children and families were offered a standard level of services in grade 1 to the extent that they could be delivered. In subsequent years criterion-referenced assessments were used to adjust the dosage of some components (tutoring, home visiting, and peer pairing) to match family and child needs. By grades 5 and 6 the monthly group sessions for parents and youth focused on how to deal with the challenges of the transition into middle school, resistance to drug use, and sexual development. In grades 7 and 8 workshops were held relating to indentity and vocational goal setting. From grades 7 to 10 individualized intervention plans were developed and implemented with each youth, based on triennial assessments of risk and protective factors (Conduct Problems Prevention Research Group, 2006).

Ninety-six percent of parents and 98% of children participated during grade 1, with 79% of parents and 90% of children attending at least 50% of all groups (Conduct Problems Prevention Research Group, 2002b). On average, parents attended 16 of the 22 groups that were offered and children attended 17 of the 22 groups. Eighty-eight percent of parents and 92% of children participated in grade 2, with 79% of parents and 87% of children attending at least 50% of all groups. On average, parents attended 10 of the 14 groups, and children attended 11 of the 14 groups. Eighty-eight percent of parents and 91% of children participared in grades 3 to 6, with 45% of parents and 63% of children attending at least 50% of all groups. On average, parents attended 15 of the 36 groups offered across these 4 years (9 in each grade), and children attended 21 of the 36 groups.

Eighty-six percent of parents and children received individual sessions tailored to address their specific needs in grades 7 to 9. Eighty-four percent of parents and children received services focused on positive youth development during this time, 82% of parents and children received services focused on family functioning, and 84% of parents and children received services focused on academic success. On average, parents and children received 56, 82, and 27 individual sessions in each of those areas, respectively, across the 3 years.

In addition to indicated interventions, a universal intervention was provided to the classrooms in intervention schools. This curriculum, an adaptation of the Promoting Alternative Thinking Strategies curriculum (Kusche and Greenberg, 1993), was designed to promote social and emotional competence and a more competent and less aggressive social ecology. Teachers implemented this classroom-level program throughout grades 1 to 5, teaching an average of 2 to 3 lessons per week. The universal intervention included weekly teacher consultation for lessons and classroom behavior management.

Intervention fidelity was ensured by manualization of all components, regular cross-site training and communication, weekly staff training, and ongoing clinical supervision. Outside interventions were neither encouraged nor discouraged and were assumed to occur at the same rate for intervention and control groups. The control condition was a “treatment as usual” comparison that included regular school prevention programs. No other special community

services were available to intervention children and no typical services were denied to either intervention or control children.

Outcome Measures

Psychiatric Criterion Counts and Disorders—The Parent Interview version of the NIMH Diagnostic Interview Schedule for Children is a well-validated, highly structured, laptop computer-administered, clinical interview to assess *DSM-IV* symptoms in children and adolescents ages 6 to 17 years. We used version 2.3 in grade 3 (and the published anticipated *DMS-IV* criteria for diagnosis at that time) and version IV in grades 6 and 9 (Shaffer et al., 1996; Shaffer et al., 2003; Shaffer and Fisher, 1997). Lay interviewers, not informed about intervention status, were trained in clinical methods and scoring accuracy by Prudence Fisher of Columbia University (or someone trained directly by her) until she or the other trainer concluded that each interviewer had reached criteria. Administration took place in the child's home with the primary parent, usually the mother, during the summer following grades 3, 6, and 9. Variables were computed for past-year criterion counts and diagnoses for conduct disorder (CD), oppositional defiant disorder (ODD), and attention-deficit/hyperactivity disorder (ADHD) criteria. Criteria were solicited for the past 6 months for ODD and ADHD, and for the past 12 months for CD. The ADHD variable omitted *DSM* criteria based on age of onset and criteria in more than one setting, and so the term "ADHD criterion" was used instead of "diagnosis." CD scores were based on 15 criteria derived from 23 symptom items, with actual scores ranging from 0 to 9. ODD scores were based on 8 criteria derived from 12 symptom items, with scores ranging from 0 to 8. ADHD scores were based on 18 criteria from 23 symptom items, with scores ranging from 0 to 18. Diagnoses for grade 3 followed from *DSM-III-R* criteria, and diagnoses for grades 6 and 9 followed from *DSM-IV* criteria. In addition to criterion counts and diagnoses for each of these three conditions, a dichotomous score was derived for the presence of any externalizing disorder (ANY), indicating diagnosis of any of the three disorders.

Antisocial Behavior—Items from Huizinga and Elliot's (1987) commonly used Self-Report of Delinquency instrument were administered to youth in their homes after grades 6 and 9. For the grade 9 administration, the youth reported the number of times within the past year that each of 34 problem behaviors was committed. Three status-offense items ("skipped school," "ran away from home," and "lied about age to get something") and 6 minor-offense items were deleted so that all of the remaining 25 items indexed serious and criminal antisocial behavior. To minimize skewness in scoring, item responses were coded as 0 (never), 1 (1 time), or 2 (more than once). This instrument yielded a summary score that we called antisocial behavior (ASB) that included items such as "stolen an item greater than a hundred dollars in value," "sold heroin or LSD," "attacked someone with intent to hurt," and "had sex with someone against their will." Scores ranged from 0 to 32, but 90% of scores in the normative population were below 6. For the grade 6 administration, only 20 items were administered because 5 items were deemed unlikely and offensive for that age (e.g., "had sex with someone against their will").

Statistical Model and Treatment of Missing Data—An intent-to-treat design including all of the participants was used to assess intervention effects. To account for sporadic missing data, 20 datasets were subjected to multiple variable imputation using PROC MI in SAS version 9.1, using a model that included all outcome variables as well as indicators for race, sex, cohort, site, 20 continuous preintervention covariates, initial severity-of-risk score, and measures reported in previous publications including academic performance, social competence, peer relationships, child behavior, and parenting practices from grades 1, 3, 4, and 5. These preintervention covariates were identified based on theoretical and empirical research on the antecedents of conduct problem behaviors and are listed in Table 1. Twenty imputations should

be ample given the degree of missing information in these analyses (Schafer, 1997). Given the low rate of attrition, the impact of any violation of the missing-at-random assumption is apt to be limited. The imputation was performed separately for outcomes at each grade level, and only variables collected at or before the outcome year were included in the imputation process. For example, for grade 3 analyses, variables collected before and during grade 3 were included, but scores for grade 4 or higher were not included in the imputation. Missing data rates for individual variables in the model ranged from 0% to 24%. Because imputation from a covariance matrix, as PROC MI uses, preserves only the estimated variances and covariances when generating imputed datasets, other effects, such as interactions between intervention status and other variables in the model, tend to be artificially weakened by the conventional imputation process. By imputing separately by intervention status, we allow the covariances among the other variables to differ by intervention, which is the definition of an interaction.

Scores for each of the continuous outcome variables were reasonably normally distributed and therefore subjected to a multilevel, parametric, hierarchical liner model (HLM) that took into account the fact that children were clustered within schools at the time of random assignment with possible interdependence of scores. The first HLM model included level 1 (child level) scores for continuous severity-of-initial-risk (mean centered); four child characteristics (ethnicity, sex, cohort, and site); 20 continuous baseline covariates (mean centered); the two-way interaction between intervention condition and severity-of-initial-risk; two-way interaction terms for intervention × each child characteristic (ethnicity, sex, cohort, and site); and three-way interaction terms for intervention × severity-of-risk × each child characteristic (ethnicity, sex, cohort, and site). The level 2 (school) variable was assignment to intervention or control group. The coefficients for each of the 20 imputed datasets were combined following Rubin's rule (Rubin, 1987). None of the three-way interaction terms or the two-way interaction terms involving the four child characteristics was statistically significant, indicating to differential effects as a result of sex, ethnicity, cohort, or site. The pattern of results did not differ when the 20 covariates were removed from the models, but these variables were retained to improve precision of measurement. A final multilevel model was estimated that included only the two-way interaction between intervention and severity-of-initial-risk, as well as 20 continuous baseline covariates (mean centered), the severity-of-initial-risk, an indicator for receiving the intervention, and indicators for the four child characteristics. For the dichotomous outcome variables, logistic regression analyses were performed following a similar analytic framework to that described above.

To understand significant interaction effects between intervention and the continuous severity-of-risk factor, means were computed and contrasted for each of two levels of severity of initial risk (most severe 3% of the normative population [called highest risk], and lower than the highest 3% [called moderate risk]). The 3% cutoff was selected because it represents a common standard for defining psychiatric caseness in externalizing problems in youth.

Statistical power analysis, using conservative estimates of .05 for the average intracluster correlation indicated a power of 0.80 to detect a treatment main effect size of 0.26. The intracluster correlations and proportions of variance accounted for by the covariates are not directly available for multiply imputed datasets in PROC MIANALYZE for PROC MIXED, so they were estimated. Given that intervention assignment was random, power to detect an interaction would not be greatly reduced from the power to detect a main effect. Thus, we concluded that we had sufficient power to detect an interaction of small to moderate magnitude.

RESULTS

Grade 3

Criterion Counts—Assignment to intervention did not result in a significant main effect for any of the three variables (CD, ODD, or ADHD); however, significant interaction effects between intervention and severity of initial risk were found for ODD and ADHD. In each case the positive effect of intervention increased linearly as the severity of intial risk increased. Group means listed in Table 2 and statistical contrasts indicate that the intervention and control groups differ significantly only for the highest risk group.

For ODD criterion counts, a significant interaction effect was found (coefficient −0.32, SE 0.14; $p < .03$). At the highest risk level the intervention group mean criterion count scores were 1.29 (confidence interval [CI] 0.8-1.8) compared to 2.09 (CI 1.5-2.7) for the control group. The normative sample mean was 0.50.

For ADHD criterion counts, a significant interaction effect again indicated that the intervention reduced criterion counts as the severity of risk increased (coefficient −0.93, SE 0.35; $p < .01$). Among the highest-risk group, mean criterion count scores were 6.64 (CI 5.4-7.9) for the intervention group and 8.14 (CI 6.8-9.5) for the control group. The normative sample mean was 3.33. No effects were significant for CD criterion counts.

Psychiatric Diagnoses—No significant main effects were found, but all four variables yielded a significant or marginally significant interaction effect that paralleled the above findings. Analysis of the ANY externalizing diagnosis variable yielded a significant interaction effect between intervention and severity of risk (odds ratio [OR] 0.68, SE 0.16; $p < .02$). Table 2 shows that the rate of ANY externalizing diagnosis was 38% (CI 27%-51%) among the highest risk intervention group in contrast with 53% (CI 41%-65%) among the control group. The rate among the normative sample was 16%.

Analysis of the CD diagnoses yielded a significant interaction effect between intervention and severity of risk (OR 0.59, SE 0.27; $p = .05$). Among the highest risk group the rate of CD diagnoses was reduced by almost half due to assignment to intervention: 11% (CI 5%-22%) of the highest risk intervention group reached this diagnosis in contrast with 20% (CI 12%-31%) of the control group. The rate among the normative sample was 4%.

Analysis of the ODD diagnosis also yielded a significant interaction effect between intervention and severity of risk (OR 0.61, SE 0.23; $p < .04$). Among the highest risk group the probability of a diagnosis of ODD was reduced by more than half: 14% (CI 7%-25%) for the intervention group compared with 31% (CI 20%-43%) for the control group. The normative sample rate was 5%.

The ADHD criterion yielded a marginally significant interaction effect between intervention and severity of risk (OR 0.74, SE 0.16; $p < .07$). Among the highest risk group 34% (CI 24%-47%) of the intervention group versus 44% (CI 32%-56%) of the control group met the criterion. The normative sample rate was 15%.

Grade 6

Criterion Counts—No significant main effects of intervention were found. Analyses of two of the four variables (CD and ADHD) yielded a statistically significant or marginally significant interaction effect between intervention condition and the continuous severity-of-initial risk score. In each case the positive effect of intervention increased linearly as the severity of initial risk increased. Group means listed in Table 3 and statistical contrasts revealed

that for each variable, the positive effect of intervention was robust for the subgroup of children at highest risk and not significant for the moderate-risk group.

For CD criterion counts, a marginally significant interaction effect was found (coefficient −0.18, SE 0.10; $p < .08$). At the highest risk level mean criterion count scores were 0.92 (CI 0.54-1.31) for the intervention group and 1.63 (CI 1.2-2.1) for the control group. The normative sample mean was 0.40.

For ADHD criterion counts a significant interaction effect again indicated that the effect of intervention on reducing criterion counts increased as the severity of risk increased (coefficient −0.77, CI −1.52 to −0.30; $p < .02$). Among the highest risk group mean criterion count scores were 3.62 (CI 2.57-4.66) for the intervention group and 5.85 (CI 4.5-7.2) for the control group. The normative sample mean was 1.95. For the self-reported ASB score, no effects were significant.

Psychiatric Diagnoses—No main effects were found, but analyses of ANY diagnosis and CD yielded marginally significant interaction effects that paralleled the above findings (see Table 3). Analyses of the ANY externalizing diagnosis variable yielded a marginally significant interaction effect between intervention condition and severity of risk (OR 0.75, SE 0.17; $p < .10$). Among the highest risk group the rate was reduced by one third; 32% (CI 22%-45%) of the intervention group met criteria for at least one externalizing diagnosis in contrast with 48% (CI 36%-60%) of the control group. The normative sample rate was 14%.

Analysis of the CD diagnoses yielded a marginally significant interaction effect between intervention and severity of risk (OR 0.64, SE 0.26; $p < .09$). Among the highest risk group the probability of a CD diagnosis was reduced by more than half: 10% (CI 4%-21%) of the intervention group reached this diagnosis compared to 23% (CI 15%-35%) of the control group. The normative sampel rate was 5%. Analysis of the ODD diagnosis and ADHD criterion did not yield any significant effects.

Grade 9

Criterion Counts—Assignment to intervention resulted in a significant main effect for the self-reported ASB variable. Youths assigned to intervention received significantly lower ASB scores than did youths assigned to a control group (coefficient −0.79, CI −1.4 to −0.2; $p < .01$). The intervention group's mean score of 2.04 (CI 1.7-2.4) was significantly lower (by 26%) than the control group's mean score of 2.74 (CI 2.3-3.2). The main effect of intervention was not significant for CD, ODD, or ADHD criterion count scores.

Analyses of three of the four continuous outcome variables (CD, ADHD, and ASB) yielded a statistically significant interaction effect between intervention and the severity-of-initial-risk score (see Table 4). In each case the positive effect of intervention was statistically significant for the subgroup of children at highest risk and was not significant for the group at moderate risk.

For CD counts a significant interaction effect (coefficient −0.26, SE 0.09; $p < .01$), indicated lower scores for the highest risk intervention group (mean 0.63, CI 0.4-0.9) than the control group (mean 1.41, CI 0.9-1.9). The mean for the normative sample was 0.34.

For ADHD counts a significant interaction effect (coefficient −0.91, SE 0.31; $p < .003$) indicated lower scores for the highest risk intervention group (mean 2.96, CI 1.8-4.1) than the control group (mean 5.79, CI 4.5-7.1). The mean for the normative sample was 1.62.

For the self-reported ASB score the effect of intervention on reducing ASB scores (also significant for the entire sample) increased with the severity of risk (coefficient −0.58, SE 0.28; $p < .04$). Among the highest risk group, the intervention group's mean (mean 1.99, CI 1.2-2.8) was lower than the control group's mean (mean 3.94, CI 2.4-5.5). The mean score for the normative sample was 1.66. No effects were significant for ODD criterion counts.

Psychiatric Diagnoses—No main effects were significant, but analysis of three of the four diagnosis variables yielded a significant interaction effect that paralleled the above findings (see Table 4). Analyses of the ANY externalizing diagnosis yielded a significant interaction effect between intervention condition and severity of risk (OR 0.67, SE 0.19; p .04): 26% (CI 16%-38%) of the highest risk intervention group were diagnosed with ANY externalizing disorder, in contrast to 46% (CI 34%-59%) of the control group. Of the normative sample 13% received at least one diagnosis.

CD diagnoses yielded a significant interaction effect between intervention and severity of risk (OR 0.47, SE 0.33; $p < .03$). In the highest risk group the probability of a CD diagnosis was reduced by more than three fourths: 5% (CI 2%-15%) of the intervention group reached this diagnosis in contrast with 21% (CI 13%-33%) of the control group. The rate for the normative sample was 4%.

The ADHD criterion also yielded a significant interaction effect with severity of risk (OR 0.62, SE 0.22; $p < .03$). Among the highest risk group the probability of ADHD was reduced by more than half; 16% (CI 9%-28%) of the intervention group as compared to 34% (CI 23%-46%) for the control group reached criteria for a diagnosis. Among the moderate-risk youth, the rates for the intervention and control groups were 12% each. The normative sample rate was 7%.

No effects were significant for ODD diagnoses, although the pattern was in the same direction as for the other variables. Among the highest risk group 16% of the intervention group met criteria for ODD, in contrast to 28% of the control group and 7% of the normative sample.

DISCUSSION

According to study findings, random assignment to the Fast Track intervention had a statistically significant and clinically meaningful positive effect on preventing childhood and adolescent externalizing psychiatric disorders and antisocial behavior, but only among the highest risk subgroup of kindergarteners. Intervention effects were detected as early as grade 3 and were robust through grade 9. Among the highest risk group in grade 9 assignment to intervention was responsible for reducing the risk of Cd cases by 75%, of ADHD by 53%, and 43% of all externalizing psychiatric disorder cases. Thus, the findings were both statistically significant and clinically meaningful. In contrast, the intervention had limited impact on children who were initially at only moderate levels of risk. The exception to this pattern was a significant main effect of intervention on self-reported antisocial behavior scores at the end of grade 9. These findings challenge the assumption that high-risk young children are impervious to change and join the growing body of descriptive literature on person × environment interaction effects in antisocial behavior (Caspi et al., 2002; Dodge and Sherrill, in press). Long-term, developmentally appropriate services that target child social-cognitive and cognitive skills, peer relationships, and parenting improved antisocial outcomes for highest risk youth.

One of this study's strengths is its evaluation of the supplemental impact of the Fast Track intervention beyond standard community care for at-risk children. The control group in this kind of study cannot ethically be a "treatment-withheld" comparison, so these children were allowed to receive whatever interventions were available to them in their communities.

Documentation indicates that routine services in special education, mental health, and juvenile justice for high-risk youth are costly and available (Jones et al., 2002).

The analyses reported here indicate that these findings do not vary significantly across sex groups, across four geographic sites at which the intervention occurred, or across three cohorts of children. Given the high sample retention and few differences between children who remained in the study and those who did not, the study's findings (likely chance) can be generalized to a large segment of high-risk American children. The robustness of this approach to intervention across these diverse groups of children improves its utility for dissemination across diverse contexts, although future studies should still test its generalizability.

A somewhat surprising finding was the developmental variation in outcome effects. That is, more favorable effects were found on CD and ODD diagnoses at grades 3 and 9, as compared to grade 6. We do not have a precise explanation for this finding, but two factors may be considered. First, the findings for grade 6 are significant for ADHD symptoms and effects for CD and ADHD diagnosis were trends, thus showing the same patterning, albeit less strong at grade 6. Second, it may be that the effects of intervention were somewhat disrupted by the transition to middle school and the decrease in intervention services after entrance to middle school. These findings point out the need in prevention trials to follow participants past the middle school period and into later adolescence where similar developmental trends have been found in other prevention trials (Vitaro et al., 1999).

Although the effects on the highest risk group are robust and favorable, given the high cost of this intervention (about $58,000 per youth over 10 years; Foster et al., 2006), one may wonder whether the benefits will outweigh the intervention costs. Cohen (1998) estimated that high-risk youth cost society $1.2 to 2 million each in rehabilitation, incarceration, and costs to victims. At an intervention cost of $58,000 per youth, an intervention must reduce such costly outcome cases by just three to five percentage points to be cost beneficial. The effect size among the highest risk group in the present study indicates that CD diagnoses were reduced by 16 absolute percentage points and overall externalizing psychiatric cases were reduced by 20 absolute percentage points, suggesting that large economic savings may ultimately accrue with this intervention if it is directed to the highest risk group.

These same analyses point toward a suggestion for how to maximize the cost-effectiveness ratio for preventive interventions such as Fast Track. The cost-effectiveness ratio increased linearly with increasing level of initial risk. Thus, it follows that limiting selection to the highest risk group would maximize the investment in prevention.

Limitations

Several limits of the present study temper the implications of the findings. First, whether the effects of intervention will last into adulthood is unknown. Because the intervention was still being implemented at the time of the outcomes reported here, it is plausible that the temporary scaffolding, support, and monitoring provided by the intervention staff was responsible for the interruption of antisocial behavior and that, once the intervention ceased, the effects would dissipate. The Fast Track intervention terminated 1 year after the current outcomes were measured; thus, continued follow-up of these youth after intervention ends in adulthood is crucial. Second, as schools were selected for high rates of local crime and poverty, these findings require confirmation in schools with average or lower levels of crime and poverty.

Third, because the Fast Track intervention includes a variety of services in several domains at different ages (just like the Olds et al. [1998 nurse-practitioner home-visitation program), it is not known whether the entire program is necessary or which components of the intervention are most crucial to positive outcomes. The comprehensive intervention addressed child social-

cognitive and cognitive development, peer relationships, and parenting across 10 years. It is plausible that one or more components accounted for most of the impact. Mediation analyses may help sort out the most potent components, but future factorial experimental studies are needed to parse the program into components. Finding the minimally essential components may also bring the advantage of enhancing the cost-effectiveness ratio of the intervention.

Fourth, the positive effects of intervention on ADHD criterion counts may seem confusing given that ADHD is likely biologically driven. The reported ADHD scores, however, are a function of the rater's (i.e., the primary caregiver) perspective of the child's behavior. Raters may implicitly refer to conduct problems when responding to questions pertinent to ADHD, and so favorable intervention for conduct problems may reduce the perceived severity of ADHD symptoms. The effect of conduct problems on raters' perceptions of ADHD symptoms may also be an important issue for the psychiatric assessment of ADHD. In addition, unlike the *DSM*, our criterion for ADHD did not require early age of onset (because, by design, we assessed current symptoms only), so the possibility that current conduct problems could skew a perceiver's rating of ADHD symptoms was enhanced.

Finally, although the Fast Track intervention had little effect on externalizing disorder in the moderate-risk group, it is inappropriate to conclude that no intervention with these children would be efficacious. During the years immediately following the initial screening, when comprehensive and intensive prevention services were provided to the entire high-risk sample, the program had significant main-effect impact on the entire group of participants (Conduct Problems Prevention Research Group, 2004). Over time, the design of the prevention program was to gradually phase out group interventions and focus more intensive individual services (home visiting, academic tutoring, mentoring) on those who demonstrated the greatest need. The interaction effects with risk status seemed to emerge over time. Hence, it is possible that this focus on intensive, individualized intervention may have led to diminished effects in the moderate-risk group, or that the intensive individualized service model was most useful only to the highest risk youth and families. It is also possible that the moderate-risk children require different kinds of support than were given in this program. Yet another possibility is that the outcome measures reported here did not fully assess the adaptation of the moderate-risk group. Their rates of serious problem behavior as measured here may have been too low to detect an effect of intervention; 24% of the total sample scored within the normal range on the teacher ratings of externalizing in kindergarten. It is unclear whether different measures would be more sensitive to intervention effects for this group.

Clinical Implications

These findings support the importance of screening when selecting children for comprehensive preventive interventions, Assignment to intervention had a clearly favorable impact on children in the highest 3% of the population in terms of risk but little positive impact on the moderate-risk children, although the relation between risk level and intervention effectiveness was seen to be linear and gradual. Although there is no sharp cutoff for effectiveness, practitioners faced with selection questions for this kind of comprehensive and costly intervention would likely maximize cost-effectiveness by focusing on the highest risk group. Clinical researchers in search of higher levels of statistical power would be wise to resist increasing sample sizes merely by reaching farther down in risk levels to obtain larger samples When intervention studies allow large enough sample sizes, researchers should test for intervention effects that interact with initial risk level.

In conclusion, this study demonstrates for the first time that early intervention can reduce long-term, serious conduct disorders in high-risk children. The fact that the intervention extended over a greater length of time than previous interventions may account for its success, but this is an issue for future inquiry. This study challenges the hypothesis that high-risk children are

impervious to intervention, and it provides hope for these children and the practitioners who are charged with intervening with them.

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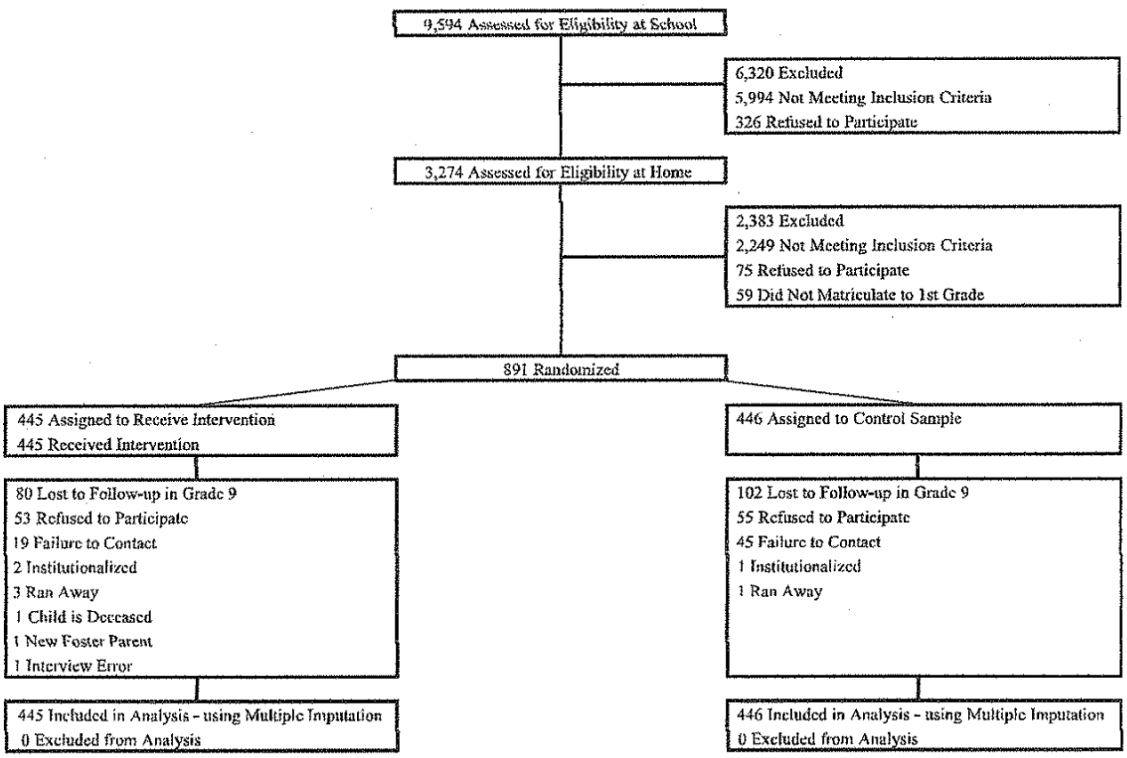

Fig. 1.
Consort diagram.

TABLE 1

Preintervention Means, Standard Deviations, and Differences Across Conditions

Variable	Range	Intervention		Control		df	t	Pr > |t|
		Mean	SD	Mean	SD			
Baseline child behavior problems								
Parent daily report of oppositional + aggressive behaviors (proportion of behaviors occurred)	0-0.8	0.26	0.17	0.27	0.17	886	0.84	0.40
TOCA-R Authority Acceptance Behavior Mean Scale score	0-5	2.18	0.95	2.24	0.96	883	0.93	0.35
Family demographics and social ecology								
Hollingshead Socioeconomic Status	4-66	24.58	12.91	24.17	12.46	886	-0.48	0.63
CES-D Maternal Depression Scale	0-57	15.83	9.84	16.81	10.42	888	1.43	0.15
Mother-rated family satisfaction, from Inventory of Parent Experiences	0-3	2.11	0.76	2.18	0.68	882	1.5	0.13
Mother-rated friendship satisfaction, from Inventory of Parent Experiences	0-3	2.30	0.65	2.37	0.57	885	1.83	0.07
Maternal Stressful Life Events Scale	0-24	5.25	4.24	5.3	3.97	882	0.17	0.87
Neighborhood dangerousness rating	-2 to 1.5	-0.05	0.61	-0.03	0.59	888	0.51	0.61
Child's cognitive and social skills								
WISC Intelligence Standardized score	-2.4 to 3.1	-0.04	0.8	-0.11	0.78	887	-1.18	0.24
Hostile attributional bias to peers' intentions (% of items)	0-1	0.67	0.25	0.67	0.25	888	-0.24	0.81
Aggressive behavior responses to hypothetical provocations	0-40	22.57	8.29	22.14	8.1	886	-0.79	0.43
Appropriateness score for emotion understanding, from interview on emotional experience	0-4	3.58	0.72	3.55	0.8	889	-0.51	0.61
Social competence rating by parent	0-3.75	2.09	0.59	2.0	0.58	888	-2.45	0.01
Reading Readiness, Woodcock-Johnson Letter Word Identification	0-40	13.05	4.98	12.18	4.01	887	-2.84	0.01
Emotional recognition skill, no. correct	2-16	10.73	2.77	10.69	2.84	875	-0.21	0.84
Social problem-solving skill, proportion of competent responses	0-1	0.61	0.22	0.64	0.22	885	1.43	0.15
Parenting behavior								
Appropriate discipline score, from parent questionnaire	1.1-2.8	2.01	0.28	1.99	0.28	883	-0.79	0.43
Physical punishment of child, from Life Changes Scale	0-1.67	0.21	0.22	0.24	0.24	887	2.17	0.03

Variable	Range	Intervention		Control		df	t	Pr > |t|
		Mean	SD	Mean	SD			
Verbal punishment of child, from Life Changes Scale	0-2	0.25	0.32	0.27	0.31	887	1.03	0.30
Warmth toward child, from Observed Interaction Rating Scale	1.1-5	3.62	0.8	3.54	0.78	886	-1.55	0.12

Note: Instruments are described in detail at www.fasttrackproject.org. TOCA-R = Teacher Observation of Child Adjustment-Revised; CES-D = Center for Epidemiological Studies-Depression Scale.

TABLE 2

Grade 3 Mean for Each Variable, by Risk Group and Intervention Condition, and Tests of Intervention[a]

Variable	Highest Risk (Top 3rd Percentile)		Moderate Risk (<Top 3rd Percentile)		Normative Sample *N* = 385	Intervention Between Intervention and Risk
	Intervention *N* = 70	Control *N* = 72	Intervention *N* = 375	Control *N* = 374		
Mean criterion count						
CD	0.88	1.33	0.68	0.58	0.46	NS
ODD	1.29*	2.09	1.07	0.96	0.50	$p < .03$
ADHD	6.64**	8.14	5.41	5.08	3.33	$p < .01$
Proportion receiving psychiatric diagnosis						
ANY	0.38*	0.53	0.35	0.30	0.16	$p < 0.2$
CD	0.11+	0.20	0.10	0.05	0.04	$p = .05$
ODD	0.14**	0.31	0.12	0.10	0.05	$p < .04$
ADHD	0.34	0.44	0.29	0.25	0.15	$p < .07$

Note: The mean criterion count figures are the mean numbers of criteria received for CD, ODD, and ADHD. ANY indicates the proportion of youth who received a diagnosis on any of CD, ODD, or ADHD. CD = conduct disorder, ODD = oppositional defiant disorder; ADHD = attention-deficit/hyperactivity disorder; NS = nonsignificant.

[a] For tests of cell contracts between intervention and control groups within risk level

+ indicates $p < .10$

* indicates $p < .05$

** indicates $p < .01$.

TABLE 3

Grade 6 Means for Each Variable, by Risk Group and Intervention Condition, and Tests of Interention[a]

Variable	Highest Risk (Top 3rd Percentile)		Moderate Risk (<Top 3rd Percentile)		Normative *N* = 385	Interaction Between Intervention and Risk
	Intervention *N* = 70	Control *N* = 72	Intervention *N* = 375	Control *N* = 374		
Mean criterion count						
CD	0.92^{+}	1.63	0.72	0.58	0.40	$p < .08$
ODD	1.52	2.33	1.39	1.27	0.67	NS
ADHD	3.62**	5.85	3.34	3.46	1.95	$p < .02$
ASB	1.50	1.26	1.2	1.00	0.63	NS
Proportion receiving psychiatric diagnosis						
ANY	0.32^{+}	0.48	0.28	0.27	0.14	$p < .10$
CD	0.10^{+}	0.23	0.09	0.06	0.05	$p < .09$
ODD	0.20	0.30	0.16	0.15	0.07	NS
ADHD	0.17^{+}	0.30	0.16	0.18	0.10	NS

Note: The mean criterion count figures are the mean numbers of criteria received for CD, ODD, and ADHD, and the mean ASB scale score. ANY indicates the proportion of youths who received a diagnosis on any of CD, ODD, or ADHD. CD = conduct disorder, ODD = oppositional defiant disorder; ADHD =attention-deficit/hyperactivity disorder; ASB = antisocial behavior scale; NS = nonsignificant.

[a] For tests of cell contrasts between and control groups within risk level.

$^{+}$ indicates $p < .10$

** indicates $p < .01$.

TABLE 4

Grade 9 Means for Each Variable, by Risk Group and Intervention Condition, and Tests of Intervention[a]

Variable	Highest Risk (Top 3rd Percentile)		Moderate Risk (<Top 3rd Percentile)		Normative *N* = 385	Interaction Between Intervention and Risk
	Intervention *N* = 70	Control *N* = 72	Intervention *N* = 375	Control *N* = 374		
Mean criterion count						
CD	0.63**	1.41	0.51	0.44	0.34	$p < .01$
ODD	1.45	2.02	1.01	1.06	0.65	NS
ADHD	2.96*	5.79	2.73	2.74	1.62	$p < .003$
ASB	1.99*	3.94	2.05	2.51	1.66	$p < .04$[b]
Proportion receiving psychiatric diagnosis						
ANY	0.26*	0.46	0.19	0.20	0.13	$p < .04$
CD	0.05*	0.21	0.05	0.04	0.04	$p < .03$
ODD	0.16	0.28	0.10	0.12	0.07	NS
ADHD	0.16*	0.34	0.12	0.12	0.07	$p < .03$

Note: The mean criterion count figures are the mean numbers of criteria received for CD, ODD, and ADHD, and the mean ASB scale score. ANY indicates the proportion of youths who received a diagnosis on any of CD, ODD, or ADHD. CD = conduct disorder; ODD = oppositional defiant disorder; ADHD = attention-deficit/hyperactivity disorder; ASB = antisocial behavior scale; NS = nonsignificant.

[a] For tests of cell contrasts between intervention and control groups within risk level

* indicates $p < .05$

** indicates $p < .01$.

[b] Main effect of intervention is significant at $p < .01$.